5.3 Chapter 5.0 Bibliography

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6.0 FUTURE STUDY NEEDS

Recognizing that this is the first comprehensive analysis of the impact of lifeline collocation on the individual lifeline's vulnerability, it is recommended that the follow-on studies be performed.

1. The collocation analysis should be repeated at another location outside of California. It will provide information on the following items:

   Is there enough data available to conduct the analysis, or was the data base available in California unique?

   Can the methods suggested by Rojahn to adjust the California data to other regions be applied to develop reasonable results?

The site can include water and sewer systems or reservoirs to assure that the collocation analysis method can properly treat the impacts of these lifelines, which were not available at the Cajon Pass.

The study can check the suitability of the LSI-MMI relationship developed for analyzing liquefaction-induced damage, the Bridge Vulnerability Index method, and the lifeline zones of influence, all of which were developed with the Cajon Pass situation in mind.

If possible, the study site should include lifeline passage over a large water body, or at least over wet ground. This will help clarify the impacts of equipment and material access time compared to lifeline repair time, as the dry ground of the Cajon Pass did not impose very restrictive "detour" conditions.

2. In parallel with the above study to further refine the collocation analysis method, a second study is warranted. It should focus on presenting the material to a broad audience. Special emphasis should be given to contacting lifeline owners and operators to discuss the study and the results obtained. Their perspective and response should provide valuable information on where improvements in the analysis method would clarify important issues that relate to the siting of lifelines in "lifeline corridors". It should also help identify mitigation approaches that reflect the operational and economic needs of the lifeline providers.

3. A longer term study is needed to provide more detailed data and expert opinion for lifelines. Most of the current data emphasizes earthquake impacts on buildings and secondly on bridges. Most of the present data (including most of the lifeline data) in the data bases were obtained from the building and bridge technical sectors. An new study to examine the present data base presented in ATC-13, but with full emphasis on lifelines, should be undertaken to allow the lifeline portions of earthquake analysis to have the same level of technical input that buildings and structures presently have.